

Pioneer F & G Telemetry and Command Processor Core Dump Program

R. Chafin and M. Pancino
Network Operations Office

The Pioneer F & G Telemetry and Command Processor Assembly Core Dump Program, DOI-5365-SP-A, provides the tracking stations with the capability of obtaining a core dump of a faulted Telemetry and Command Processor operational program with a minimum loss of track time. The program dumps core onto the Spacecraft Telemetry and Command data tape. When the dump is completed, the operational program can be reloaded. The dump can be transferred from the data tape at a later time, and can be used to diagnose the program faulting condition.

I. Introduction

One of the most frustrating classes of software problems is that which occurs in a real-time operations program during tracking operations and is not easily repeatable. If a software problem is easily repeatable, the troubleshooting can be accomplished off-line by simulating the fault-forcing condition. However, if the problem is not easily repeatable and the time is not available for immediate troubleshooting, a method of recording the faulted conditions and restoring the tracking operations in a minimum of time is needed.

One of the standard troubleshooting techniques is to make core dumps of the computer in the faulted condition. A core dump is a record of the contents of each location of memory. From the core dump the person

troubleshooting the program can deduce the state of the program in the faulted condition. He can examine the various flags used by the program as directors and the contents of various buffers that reveal the condition of the data being processed. With this tool, the source of the program problem can very often be determined.

During station tracking operations, the normal core dump capability is not available, because the primary station data processing TCP computer does not usually include a line printer onto which a core dump can be readily output. In addition, the tracking operational constraints preclude obtaining a core dump in the normal manner, even if a line printer were available, as the resumption of data acquisition from the spacecraft is the highest priority.

II. Program Description

The method described in this article was designed to provide a core dump within the capabilities and constraints of the existing tracking station network with a minimum impact on the spacecraft tracking operations. This can be accomplished by recording the core dump on magnetic tape in a format compatible with the data record format used by the operational program. A core dump of a software failure occurring during system operations can be placed on the same magnetic tape as the spacecraft telemetry and command data. Following the tracking operations, the core dump data can be separated from the telemetry and command data, and printed out on a line printer. The core dump can then be transmitted by high-speed data (HSD) to JPL for troubleshooting by the cognizant engineer.

As soon as the operational program fails, the operator records the computer display register values and then loads the Pioneer F & G Core Dump Program into the faulted TCP computer, using standard fill procedure. The Core Dump Program is loaded into a small portion of computer core. This results in the loss of any previous data in those locations. The program then halts while the operator reenters the recorded register values into the appropriate registers. The operator restarts the program. Various flags and routines are initialized (Fig. 1) and the program then samples the selected peripheral units associated with the TCP and records the state of the peripheral units in relation to the TCP. The peripheral units sampled are the station clock, Command Modulator Assembly (CMA), Symbol Synchronizer Assembly (SSA), Block Decoder Assembly (BDA), and Data Decoder Assembly (DDA). These data are then formatted into the standard block format along with selected other parameters. The core dump program then obtains the contents of the first 24 TCP core locations, i.e., 00000000 to 00000030 octal, and places them again into a block format. Subsequent core locations are placed in block formats until a total of five blocks (one mag tape record) are completed. The mag tape record is then written onto the original data record (ODR) tape forming a permanent record for later retrieval. The mag tape recording process uses the Y buffer

interlace register. The interlace register is a unit which controls the writing of the mag tape data without supervision from the central processor. The core dump program loads the interlace register with the starting location of each data group and the amount of data (the number of words) to be formatted. The mag tape unit is then started and records the data defined in the interlace register. The completion of the writing of the mag tape record generates an end-of-transmission interrupt which instructs the central processor to continue.

The program returns to the formatting routine and creates another mag tape record (five-block formats, each containing the contents of 24 TCP core locations). Each succeeding five-block record is written on mag tape until all the TCP core locations are completely recorded. Two end-of-file (EOF) marks are written on the mag tape and the program halts (Fig. 2).

On the completion of the core dump, the TCP operator reloads and initializes the Operational Program which searches the original data record (ODR) magnetic tape for two EOF marks and then continues recording the normal spacecraft data from that point on the tape.

After the pass, the core dump data can be retrieved from the ODR tape by utilizing a post-track playback computer program. The playback program is initialized for the core dump data parameters, and the ODR tape is searched for the core dump data. These data are then sent by HSD line either to JPL for investigation or looped back to the station for local investigation.

III. Conclusion

The Core Dump Program could be used to investigate the core contents of any computer program resident in the TCP; however, each mission may require a "Mission-Dependent" Core Dump Program due to the necessity of formatting the core contents of the TCP to be compatible with the recorded data from the specific spacecraft. This necessity arises from the fact that the ODR tape, complete with received data and core dump, requires a uniform format for successful playback.

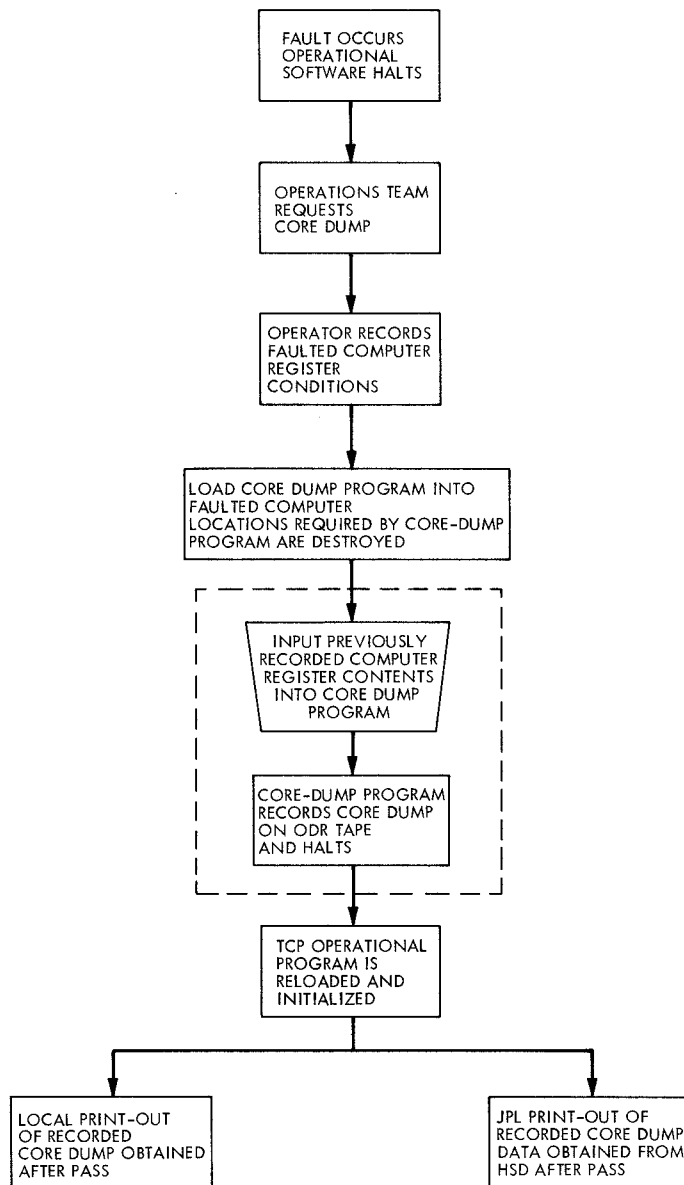


Fig. 1. Operations flow chart

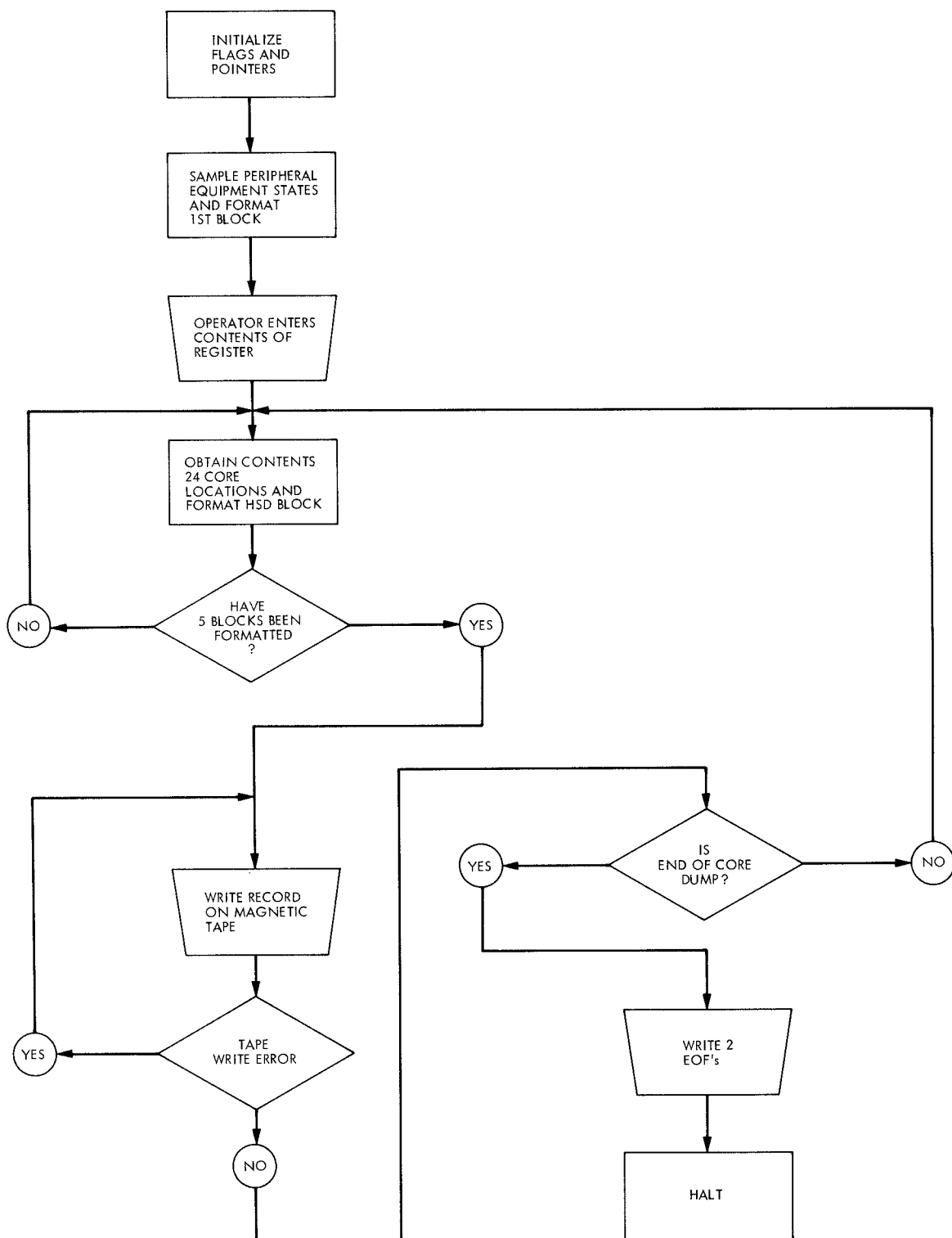


Fig. 2. Core dump functional flow chart (detail)